Britain. After this committee had made its report, but before the "Order in Council" had been signed by the Queen, an intimation was received from Professor von Helmholtz that something might be done toward international agreement if the order were delayed till he could communicate in person the results of the most recent determinations in Berlin. Accordingly von Helmholtz and some others were invited to be present at the British Association last August, and to sit with the famous B.A. "committee appointed for the purpose of constructing and issuing practical standards for use in electrical measurements." The report of the committee, recently published, says: "During the Edinburgh meeting the committee were honored with the presence of Dr. von Helmholtz, M. Guillaume of Paris, Professor Carhart of the United States Dr. Lindeck and Dr. Kahle of the Berlin Reichsanstalt. These gentlemen came by invitation to consider the question of establishing identical electrical standards in various countries." The committee had two long sessions, and there were present Professor Carey Foster, chairman, Lord Kelvin, Professors Ayrton, Perry, and Sylvanus Thompson, Dr. Oliver Lodge, Mr. Glazebrook, secretary, Mr. Preece of the Post-Office, Major Cardew of the Board of Trade Bureau, and others.

The most important results of these conferences were the abandonment of the time-honored B.A. unit, the disregard of the "legal" ohm, and the adoption of the mercury standard of 106.3 centimeters. The reports from Berlin and Paris showed most conclusively that mercurial standards, set up with the precautions recently adopted, agree with surprising accuracy. The uncertainty of the relation between the centimeter and the gramme was avoided by defining the mass of the mercury column of 106.3 centimeters in length, which has a resistance of one ohm. It is 14.4521 grammes. This corresponds to a specific gravity for mercury of 13.5956. "In reality the square-millimeter cross-section remains the elementary definition, but with the specification that this is arrived at by mercurial weighings."

Standards of resistance for industrial purposes in solid metal will still be made as heretofore. But it must be borne in mind that such resistances, especially when made of alloys, should be kept at a temperature near the one at which they have been standardized; otherwise small changes take place in the resistance, due perhaps to a kind of annealing and recrystallizing process.

It was further agreed with regard to the unit of current that the number 0.001118 should be adopted as the number of grammes of silver deposited per second from a neutral solution of nitrate of silver by a current of one ampere. This corresponds to 4.025 grammes per hour. The silver voltameter, with the proper manipulation, becomes, therefore, a secondary standard for the determination of the unit current.

The electromotive force of the Clark standard cell has been re-determined both in Berlin and Cambridge, England, within a year or two; and the results are in rather surprising agreement. A comparison of these determinations led the B.A committee to decide upon 1.434 as the number of volts representing the electromotive force of the old form of Clark cell at 15° C. containing a saturated solution of zinc sulphate and crystals in excess. This is .001 volt lower than the value heretofore assigned to this cell. It was not determined to adopt this form of cell as the standard, but only to decide upon its voltage when set up by competent persons in accordance with certain specific directions. My own form of Clark cell is perfectly portable, has an electromotive force of 1.44 volts at 15° C., and its change of electromotive force with temperature is only half as great as that of the old Clark cell containing crystals.

We have as yet in this country no bureau where concrete standards of resistance and standard instruments for other electrical units are preserved. Such a bureau, under federal control, is greatly to be desired. Germany has its Reichsanstalt, under the direction of von Helmholtz, in Berlin; England has not only the standards of the British Association in the keeping of Mr. Glazebrook at Cambridge, but also the Board of Trade Bureau in London, under the directorship of Major Cardew. Mr. Glazebrook undertakes the comparison and certification of standard coils for the English-speaking world, while the bureau in London issues certificates of instruments for commercial purposes in Great Britain.

Government bureaus mean certified standards and legally adopted units. The decisions of the B.A. committee last August were with the full concurrence of Professor von Helmholtz, and it is understood that the German government will adopt the B.A. proposals. The committee appointed by the Board of Trade in London has already made its supplementary report in accordance with the conclusions of the B.A. committee, and these units will doubtless very soon acquire a legal character in England. The coming electrical congress in Chicago will afford an opportunity for official delegates to adopt these same units for their respective countries, and official ratification will then naturally follow. Lord Kelvin (Sir Wm. Thomson) predicted at the close of the Edinburgh meeting that the system of units adopted by the B.A. committee will become thoroughly international. It should be the duty and pleasure of all electricians to contribute toward this result.

THE CLASSIFICATION AND NAMING OF IGNEOUS ROCKS.

BY W. S. BAILEY, WATERVILLE, ME.

THE discussions of Mr. Iddings[1] relating to the crystallization of lava have led him to conclusions that will undoubtedly prove of vast significance in the attempt to ground the study of rocks in a firm and sure foundation. Heretofore, most petrographers have busied themselves with descriptions of rock-types, confining their discussions principally to the mineralogical composition and the structure of the specimens studied, and to their similarity to other specimens assumed as types. Such work as this is of course absolutely necessary to the right treatment of rock classification. It is evident that we must first know the characteristics of bodies to be classified before we can hope to separate them into genetic groups. But the time has now come when students of rocks must seek for a generalization that will do for their science what the atomic theory has done for chemistry or the theory of evolution for the biological sciences, viz., elevate petrography from the position of a descriptive science to that of a philosophical one. Mr. Iddings's recent studies in the causes producing the differences noted in different lavas emanating from the same volcanic centre, and the generalizations drawn from them, will go far toward affording a philosophical basis for rock classification, and, consequently, toward the inception of a broader study of rocks in their relationships to each other than has heretofore been possible.

The rocks on the surface of the earth all tend toward the production of a few simple types, in which tendency may be traced the action of chemical laws, under the definite conditions existing at the surface, producing from unstable compounds those that are most stable under these conditions.

Mr. Iddings believes that the relation existing between chemical action and the conditions under which it occurs is discoverable not only in the breaking down (degradation) of rocks, but also in their construction. He believes that the intimate gradations in composition and structure that are known to exist between the types of eruptive rocks are due to the action of chemical laws under changing but definite conditions — conditions that are determined largely by the position of the magmas from which the rocks are derived. If this be true, petrographers have at last a thread to which they can tie the results of their investigations: they have offered them a conception as to the *cause* of the existence of eruptive rock-types, whose discussion *pro* and *con* will compel them to study not simply rock-specimens, but rather rock-masses, in the attempt to learn just what relations exist between their various parts, with respect to composition and structure, and to discover the conditions under which these parts were formed. In other words, *petrography*, as the result of this discussion, will become *petrology*, just as "natural history" has become "biology."

[1] J. P. Iddings, The Origin of Igneous Rocks, Bull. Philos. Soc., Washington, vol xii, 1892, p. 89.

It is not the theory of a science which urges the progress of that science, but it is the attempt to discover whether or not the suggested theory will explain the facts of the science, that leads to the latter's rapid development. The suggestion of the atomic theory demanded its discussion, and it was this discussion that advanced chemistry to the position it now occupies among the exact sciences. The theory of evolution did not by any means explain away the difficulty of accounting for the existence of many species of living things, but it was the attempt to discover whether the theory is founded on a secure basis or not, that has led to the wonderful progress of biology within the past quarter of a century. So the mere suggestion of Mr. Iddings's theory as to the origin of eruptive rocks, because of its comprehensiveness, is bound to lead to discussion that will in the end give us a conception of the cause of the almost infinite variety among these bodies more simple than any other conception that has thus far been held.

Mr. Iddings was highly favored in the beginning [2] of his studies by the opportunity afforded him of comparing the deep-seated portions of a series of rocks with their surface equivalents. Electric Peak and Sepulchre Mountain, in the Yellowstone National Park, are separated from each other by a great fault, in consequence of which the intrusive stock and its apophyses of Electric Peak are brought to the same horizon with the dykes and surface-flows of Sepulchre Mountain.

Upon comparing the Electric Peak intrusives with the Sepulchre Mountain effusives, it was found that, although each group comprehends a complex series of rock-types, the two groups have, on the whole, a striking similarity in composition. Certain characteristic minerals found in the intrusives are also common in the effusives. Moreover, the transition between the members of each series is so very gradual that it is impossible to draw any sharp line between the different types. These facts indicate the existence of a close relationship between the typical intrusives of Electric Peak and the typical effusives of Sepulchre Mountain, and a unity of origin for the members of each series, with a gradual change in the conditions under which the different members were formed. Though the individual members of the effusives differ markedly in structure from the members of the intrusive group, the two groups are regarded as having resulted from the cooling of what was originally one mass of magma, but which, in consequence of a differentiation of its parts, became separated into various magmas differing in composition. The differentiated magmas, upon their extrusion from the depths, consolidated as widely differing rocks, either of the intrusive type, or of the effusive type, according as the magmas cooled beneath the surface or upon it.

Examination of other regions of eruptive rocks reveals the same relationship existing between the various rock-types occurring in them. There is a more or less striking similarity in some respects between all types occurring within a region covered by rocks extruded from a single centre, and a marked difference between these and the series of rocks of other regions. Thus the rocks of a single eruptive centre are more closely related to each other than to similar mineralogical aggregates originating at a different centre, or, as Mr. Iddings expresses it, the rocks of a single centre are consanguinous.

No matter how different in mineralogical composition and in structure, all the products of a given centre — consanguinous products — should be grouped together in a classification of rocks, rather than rocks of similar mineralogical composition and similar structure from widely separated regions of volcanic activity. The differences in structure and mineralogical composition of consanguinous rocks are the result of the differentiation of the magma from which they were derived, together with differences in the conditions under which the differentiated parts of this magma were cooled. Their chemical peculiarities are the direct result of the chemical nature of the homogeneous magma before its differentiation into parts. If this notion is correct, the succession of products originating during the course of a volcanic extrusion should be "from a rock of average composition through siliceous and more siliceous ones to rocks extremely low in silica and others extremely high in silica, that is, the series commences with a mean and ends with extremes."

It will be the endeavor to discover whether this law of succession expresses the facts in the case or not, that will advance the science of petrography to that of petrology. If Mr. Innings's law of succession is found to hold, the future classification of rocks will be based upon the principle of consanguinity; there will be grouped in the same great division types of different mineralogical composition and of different structure, while the different great divisions will be based primarily upon chemical considerations. What these chemical considerations are to be it is difficult at present to foresee.

Whatever may be the future classification of rocks, however, it is quite certain that petrographers are in the main right in distinguishing between rocks of different structures and different mineralogical composition by different names. There is a fashionable tendency apparent among English and American petrographers to decry the habit of naming these slight differences, not because the number of rock-types in nature is in reality small, but simply because the terminology of petrography by the addition of these names becomes large — as if we could increase the simplicity of the science by refusing names to the objects of whose study it consists. The same tendency has been observed also in the history of chemistry. Some inorganic chemists have objected seriously to the introduction of the many new terms into organic chemistry, and yet nothing has done more to advance this particular phase of the science than its system of nomenclature. It is easily understood why *geologists* should object to the increase in rock names, since this increase necessitates a greater amount of labor upon their part in becoming acquainted with the terms. But why *petrographers* should object to a more accurate designation of the objects of their study is not understandable. It would seem to the writer that for petrographical purposes every rock-type that differs in some one essential feature from all other rock-types should receive a distinctive name, in order that its differences might be emphasized. If all the types with major characteristics in common should be grouped under the same name, we should lose sight entirely of their minor characteristics that may be exceedingly important as throwing light on the relation of composition and structure to the conditions under which the rocks were formed. Again, it is much more convenient to speak of a keratophyre than of a "granophyric granite differing from ordinary granophyre in the possession of anorthoclase instead of orthoclase." This difference between keratophyre and granophyre, though of insignificant importance from the point of view of the geologist, ought to be of considerable importance to the specialist in rocks. It may express simply a difference in the original constitution of the magma from which the rock was formed, or it may be the expression of peculiar conditions under which solidification took place. In either case the difference is of importance and should be emphasized.

It would appear that the difficulty to the geologist of acquainting himself with the complete terminology of petrography might be avoided by grouping rocks in accordance with their chemical composition and structural *similarities*, and by dividing the groups according to the *differences* prevailing among their members. Geologists need take account merely of the great groups, while petrographers would require to become acquainted with their subdivisions.

In denying the necessity of expressing in their names the comparatively slight differences noted between many rocks, it will not do to say that petrography is simply a branch of geology and that there is no room for the study apart from geology. The methods of petrography are entirely different from those of geology; in many cases they are as different from those of the last-named science as are those of paleontology. Petrography is the special science dealing with some of the materials of geology. Unless it is recognized as distinct from geology it will never become of the importance that it will otherwise assume, and cannot aid geology as it should do. If it be regarded as something worthy of study for its own sake, then it is necessary to label the objects of its study so that they may be handled conveniently,

[2] The Eruptive Rocks of Electric Peak and Sepulchre Mountain, Yellowstone National Park. 12th Ann. Rep. Director U. S. Geol. Survey, p. 569.

and it is advisable to express as much in the labels as may suffice for a pretty complete knowledge of the objects labeled. If this notion is a correct one, let us welcome the designation of *differences* in rocks by their names, and not seek to lose sight of these differences in contemplating simply likenesses. On the other hand, it is well to exercise care in the selection of types to be named, so as to avoid as far as possible the lumbering of the terminology with needless expressions. Discrimination must, of course, be exercised in the naming of types, and experience must decide as to the value of any proposed name. The writer would prefer that the *varietal* names should be based upon mineralogical composition, and that adjectives should express the structural *differences*, where the structure of the variety departs from the characteristic structure of the group.

CLOUD CLASSIFICATION.

BY CAPT. DAVID WILSON-BARKER, R N., H.M.S. "WORCESTER," ENGLAND.

FOR some years meteorologists have been in doubt as to the nomenclature of clouds, greatly to the retardment of this important and practical branch of the science. The nomenclature of Luke Howard answered very well for a time, but with our advanced knowledge it scarcely answers at all. It is not simple enough for beginners, nor elaborate enough for those well advanced. Many of the systems proposed lately are simply modifications of this old nomenclature, and retain its faults. Unfortunately, in cloud classification we are met with many difficulties at the outset, we cannot collect and label clouds in a cabinet for reference, but here photography may aid us much. From personal experience it has been found quite possible to portray even the most delicate and fleecy clouds with sufficient accuracy to leave no doubt as to their type. It is proposed in this article to lay before the readers of *Science* a simple scheme of cloud nomenclature suitable for beginners and those unable to devote much time to the study. On this simple scheme can be founded a more elaborate system for skilled nephologists.

It will soon strike any one who notices weather phenomena ever so casually, that clouds have a tendency to assume one of two well-known forms or shapes, either a heapy or globular form, or that of thin sheets or layers. Clouds in the first form are known as cumulus (cumulus, a heap) clouds. In the second as stratus (stratus, a layer) clouds. Once it is clearly understood that all clouds be divided into these two types as a starting-point, and belong to one or other of these types, the question of a minute sub-division becomes, comparatively speaking, easy.

It may be well to give here a cloud definition. *A cloud is vapor, which has ascended or descended in the atmosphere from a position having a temperature or density greater than the portion of the atmosphere it ascends or descends to, which is then unable to retain it in its invisible form. According to the physical state of the position it is attracted to, so will be the form it will assume on becoming condensed.* It will be seen from this that the shape of a cloud is more or less determined by its physical surroundings, and consequently it affords a valuable index, not only to the state of the immediately surrounding atmosphere, but also to the weather we may expect, and this frequently some time before any instrumental warnings are indicated.

Cumulus is essentially the cloud of the lower atmosphere, as, although it sometimes tops to great altitudes, yet its formation commences at a, comparatively speaking, low level. Cumulus clouds assume varied and fantastic shapes, and vary very often from clouds of enormous extent to small nubecules, still there is in them a distinct and marked similarity, which must be easily recognized. There are three forms of cumulus clouds from which rain falls, viz.: 1. Bold, massive cumulus with feathery tops, which appear to be composed of ice crystals, and are like the high variety of stratus known as cirrus; 2. bold, massive cumulus with all clearly defined borders, only seen in the tropics; 3. fleecy, ill-defined cumulus. The first may be accompanied by either snow, hail, or rain, with a decided increase of wind, and, in fact, is a squall, which often gives warning hours before it reaches the observer. In the second is heavy rain with little increase of wind-force, and at sea is the kind of cloud which sometimes accompanies waterspouts; and the last has only drizzling rain and no increase in wind-force.

Stratus is formed in all layers of the atmosphere. On the ground it is fog, in the lower atmosphere as covering the sky oftentimes for days in anticyclone areas; in the middle layers in broken-up or more or less circular patches constantly, though erroneously, called cirro-cumulus or cumulo-cirrus, and in the highest layers as the well-known cirrus or curl-cloud. It is the cloud of the finest settled weather, and also of the front of cyclonic disturbances, but there can be no mistaking these two conditions. In the former case, it forms a pall over the whole sky, perhaps broken here and there by a rift, through which a blue sky, quite free from other clouds, may be seen, and appearing in all directions in lines parallel to the horizon. The first sign of any change is preceded by the disappearance of this cloud, and the formation of fine threads of cirrus over the sky; these threads gradually grow closer and closer together until the sun or moon shines through surrounded by a halo. As the cloud gets thicker (seems to grow in the air) this too disappears, rain begins to fall, and a cyclonic disturbance is well under way. In the first case the stratus was in the form of a cloud of great superficial extent and small depth, in the second it has great depth and uniformity of texture.

Cloud observing is a difficult branch of meteorology, yet no great advances can be made in the physics of the atmosphere until we have a better knowledge of its movements, and this article is written in the hope that those interested in the subject may not be appalled by the apparently hopeless condition of cloud nomenclature. For if we could have a series of observations taken carefully on even this simple basis, they would be of more value than the majority of observations taken now; and this especially applies to observations at sea, as it is to the sea we must look for the most valuable meteorological observations. Personal experience has shown that observers, while finding it comparatively easy to distinguish between cumuliform clouds and stratiform clouds and the different altitudes at which they float, yet often make great mistakes when they have to deal with the subdivisions as they are at present determined.

NOTES AND NEWS.

FIVE lectures on anthropology are to be given on Monday afternoons by Daniel G. Brinton, M.D., LL.D., at the Philadelphia Academy of Natural Sciences, admission free. Tickets can be obtained at the Academy from Dr. E. J. Nolan, secretary. Feb. 13, The Bonds of Social Life; Feb. 20, The Growth of the Arts; Feb. 27, The Progress of Religions; Mar. 6, Language and Literature; Mar. 13, Folk-Lore, or the Past in the Present.

— The Royal Academy of Sciences of Turin announces that the ninth Bressa Prize, consisting of 10,416 francs, will be awarded to any scientific author or discoverer who, during the years 1891–94, shall, in the judgment of the Academy, have made the most important or useful discovery or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology, and pathology, as well as geology, history, geography, and statistics.

— From the American Book Company we have received the four latest volumes of their English Classics for Schools. They are: "Ivanhoe," by Sir Walter Scott (484 pages, 50 cents); "Julius Cæsar," by Shakespeare (114 pages, 20 cents); "Ten Selections from the Sketch-Book," from Washington Irving (149 pages, 20 cents); and "The Sir Roger de Coverley Papers," from the *Spectator*, by Addison, Steele, and Budgell (148 pages, 20 cents). The first-named volume is provided with a serviceable glossary, and all are well printed, on good paper, and are neatly bound.